REMARKS

Favorable reconsideration of this application, in view of the present amendments and in light of the following discussion, is respectfully requested.

After entry of this amendment, Claims 22, 25-31, 35, 37 and 40-46 are pending. Claims 22, 25, 35, 37, 40 and 42 are amended, Claims 43-46 are newly added, and Claims 24, 36 and 39 are canceled without prejudice or disclaimer. No new matter is introduced.[1]

In the outstanding Office Action, Claims 22 and 24-31 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Sugawara (WO 2003/056622, hereafter "Sugawara") in view of Noguchi (U.S. Patent Application Publication No. 2003/0001277, hereafter "Noguchi"); Claims 22, 24-25, 37 and 39-41 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Takagi (U.S. Patent No. 6,174,796, hereafter "Takagi"); and Claims 35-36 and 42 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Takagi, Noguchi and Waldfried (U.S. Patent No. 6,630,406, hereafter "Waldfried").

In reply to the rejection of Claims 22 and 24-31 as being unpatentable over Sugawara in view of Noguchi, Claim 22 is amended to recite a method for cleaning a surface of a conductive layer on a semiconductor substrate placed in a reaction chamber, where the method, in part, includes:

> generating plasma containing hydrogen, helium and argon in the reaction chamber; and
>
> cleaning the part of the conductive layer exposed through the bottom of the via hole using the plasma,
>
> wherein *a residual organic material on the part of the conductive layer exposed through the bottom of the via hole is ashed by the plasma while the surface of the part of the conductive layer exposed through the bottom of the via hole is reduced without damaging the insulating layer.* (Emphasis added).

[1] Non-limiting support for the amended claims and new claims may be found at least at pages 14-16 of the specification and in the claims as originally filed.

Turning to the primary reference, Sugawara describes a method of exposing a semiconductor to hydrogen radicals excited by plasma.[2] More specifically, Sugawara describes that a silicon substrate (21) including a polysilicon gate electrode (23A) and an interlayer insulation film (24) is treated with hydrogen radicals to terminate dangling bonds therein.[3] Sugawara also describes that the treatment of the silicon substrate (21) is performed at a low temperature of 250 degrees Celsius to avoid damaging the silicon substrate (21).[4]

However, Sugawara does not describe cleaning a portion of the gate electrode (23A) using the hydrogen radicals. Instead, Sugawara describes that a contact hole formed in the interlayer insulation film (24) over the gate electrode (23A) is *filled with another material* before the silicon substrate (21) is treated with the hydrogen radicals.[5] In other words, Sugawara fills any holes that would expose the gate electrode (23) leaving no portion of the gate electrode (23A) exposed to cleaning with plasma. Further, Sugawara does not describe any organic residues on the gate electrode (23A), nor cleaning the organic residue from exposed portions of the gate electrode (23A) using the hydrogen radicals. In fact, Sugawara does not describe cleaning any surfaces of the silicon substrate (21), but only describes treating the silicon substrate (21) to terminate dangling bonds. As such, the process described in Sugawara is fundamentally different from that recited in the claims of the instant application. Conversely, amended Claim 22 recites cleaning the part of the conductive layer exposed through the bottom of the via hole using the plasma. Therefore, Sugawara fails to disclose the claimed cleaning, and Noguchi does not cure this deficiency in Sugawara. As such, no combination of Sugawara and Noguchi describes every feature recited in amended Claim 22.

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[2] Machine translation of Sugawara, abstract.
[3] Machine translation of Sugawara at pages 10-11; see also Figures 6A-6B.
[4] Machine translation of Sugawara at pages 9-11.
[5] Machine translation of Sugawara at page 7; see also Figures 6A-6B.

Moreover, Noguchi describes a semiconductor integrated circuit device, and a methodology for manufacturing the same.[6] As part of the method of manufacture, Noguchi describes plasma treatment of copper interconnections (46a to 46e) and a silicon oxide film (39) formed on the semiconductor integrated circuit.[7] Noguchi also describes that the plasma treatment is carried out in a temperature range of 350 to 450 degrees Celsius.[8]

However, Sugawara describes that high-temperature plasma treatment damages the silicon substrate (21) and describes maintaining the plasma treatment temperature at 250 degrees Celsius.[9] As such, the combination of Sugawara teaches away from the plasma treatment temperature range described in Noguchi insofar as Sugawara describes maintaining the temperature at 250 degrees Celsius or below to avoid silicon substrate damage, but Noguchi describes a plasma treatment temperature range of 350-450 degrees Celsius. Thus, it is submitted that the combination of Sugawara and Noguchi is improper and should be withdrawn. Accordingly, amended Claim 22 and any claim depending therefrom patently define over the combination of Sugawara and Noguchi for the reasons above. Therefore, it is respectfully requested that the rejection of Claim 22 and 24-31 under 35 U.S.C. § 103(a) be withdrawn.

Turning to the rejection of Claims 22, 24-25, 37 and 39-41 as being unpatentable over Takagi in view of Noguchi, the amendments to Claim 22 described above are believed to patently define over these references for the following reasons.

Takagi describes a method of manufacturing semiconductor devices that include copper wiring.[10] More specifically, Takagi describes removing copper oxide (5a) formed on wiring (5) during manufacturing by annealing the silicon substrate (1) including the copper wiring (5) in an atmosphere of hydrogen and argon and at a temperature between 200 and 400

[6] Noguchi at paragraph [0008].
[7] Noguchi at paragraph [0192].
[8] Noguchi at paragraph [0197].
[9] Machine translation of Sugawara at pages 9-11.
[10] Takagi at column 1, lines 50-10.

degrees Celsius.[11] Takagi also describes that the copper oxide may be removed by plasma reduction in an atmosphere of argon and hydrogen.[12]

However, Takagi does not describe removing an organic residue from the wiring (5). Instead, Takagi merely describes reducing the copper wiring (5) to remove oxygen therefrom, but nowhere describes that a residue is present on the copper wiring (5) or that this residue is removed through ashing with plasma. As discussed above, amended Claim 22 recites that a residual organic material on the part of the conductive layer exposed through the bottom of the via hole is *ashed by the plasma while the surface of the part of the conductive layer exposed through the bottom of the via hole is reduced.* Further, Takagi does not describe preventing damage to the silicon substrate (1). Therefore, Takagi fails to disclose the claimed cleaning step, and Noguchi does not cure this deficiency in Takagi. Thus, no combination of Takagi and Noguchi describes every feature recited in amended Claim 22, and amended Claim 22, together with its corresponding dependent claims, is believed to be in condition for allowance.

Moreover, amended Claim 37 recites features substantially similar to those recited in amended Claim 22, and is thus believed to be in condition for allowance, together with any claim depending therefrom, for substantially similar reasons. Accordingly, it is respectfully requested that the rejection of Claims 22, 24-25, 37 and 39-41 under 35 U.S.C. § 103(a) be withdrawn.

As all other rejections of record rely upon Takagi for describing the above-distinguished features, and the above-distinguished features are not disclosed or suggested by Takagi, alone or in combination with any other art of record, it is respectfully submitted that a *prima facie* case of obviousness has not been presented. Therefore, it is respectfully requested that the rejection of Claims 35-36 and 42 under 35 U.S.C. § 103(a) be withdrawn.

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[11] Takagi at column 5, lines 15-34.
[12] Id.

Further, new Claims 43-46 recite features not disclosed in any art of record and are believed to be in condition for allowance.

For the reasons discussed above, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for allowance. Therefore, a Notice of Allowance for Claims 22, 25-31, 35, 37 and 40-46 is earnestly solicited.

Should, however, the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact Applicants' undersigned representative at the below-listed telephone number.

Respectfully submitted,

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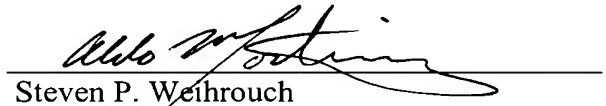

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